

Perry Lake Water Quality Summary

2006-2015

The **US Army Corps of Engineers** (USACE) Water Quality Program collects monthly water samples at Perry Lake from the beginning of April through September. These figures present data collected between 2006-2015 from four lake sites (#2,3,6,13) and the outflow (#1) below the dam. Thirty-four chemical, physical and biological parameters are measured to evaluate water quality. USACE uses this data to describe conditions and changes from the inflow streams, within the main lake, and outflow focusing on eutrophication, nutrients, sediment, herbicides, metals, and contaminants.

Perry Lake:

Built on Delaware River reaching full pool in 1970

- **Watershed** = 1,117 sq miles; 714,880 Acres (A)
- **Capacity**: Flood Control: 515,795 Acre-Feet (AF); 25,347 Surface-Acre (SA)
- **Multipurpose Pool**: 209,513 AF; 11,146 SA; 160 miles of shoreline
- **Avg. annual inflow**: (2006-2015)=412,464 AF; 2015 inflow= 690,095 AF
- **Operating project purposes**: flood control, recreation, water supply, navigation support, water quality, and fish and wildlife habitat
- **Water Quality** at Perry Lake in 2015 was beneficial to operating purposes listed above and measured parameters did not exceed KS State WQ Standards for designated uses. Water quality improves as nutrients, herbicides and sediments are removed by settling, dilution, and biological processes as water moves from inflow streams to the dam.

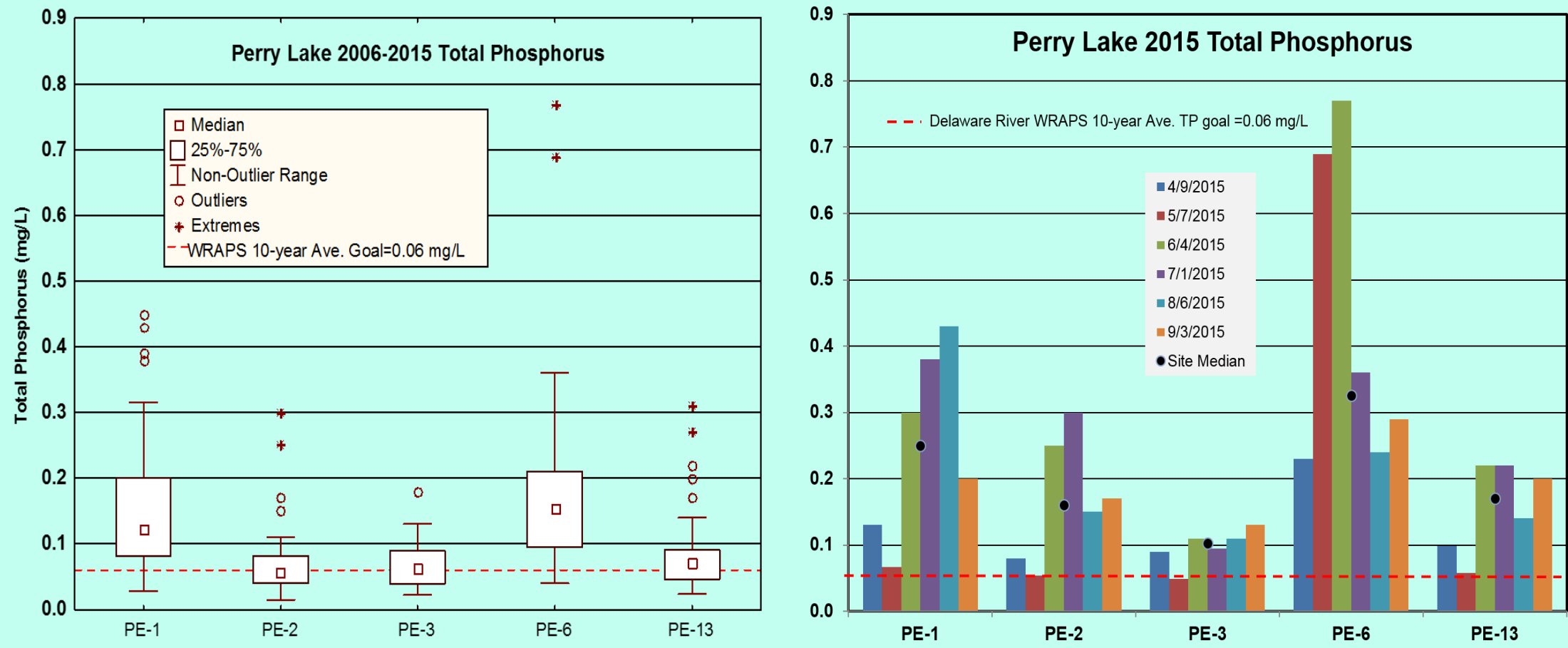
Nutrient Enrichment

Nutrients (i.e. phosphorus and nitrogen) are essential for aquatic life and are the primary factor driving fish and aquatic plant growth rates and biological productivity. Excess nutrients from urban, agricultural or natural sources increases the natural aging process in lakes. This rapid aging process, called eutrophication, is responsible for changes in plant and aquatic life in lakes and water bodies including algal blooms, low dissolved oxygen that affect fish survival, and taste and odor issues in drinking water. Perry Lake is on the 2016 KS 303(d) list of impaired waters for accelerated eutrophication. KDHE and EPA are working with water quality partners, landowners and an active Delaware River Watershed Restoration and Protection Strategy (WRAPS) group in the watershed to reduce nutrient and sediment runoff. Slowing the eutrophication process improves water quality and increases the life span of Perry Lake. In 2015, Perry Lake exceeded USACE Kansas City District lake average for total phosphorus (0.12 mg/L) near district averages for total nitrogen (0.88 mg/L) measured at the site nearest the dam. Primarily due to large inflows in 2015, both nutrient annual averages exceeded WRAPS 10-year milestones. Standard error bars in the graph measures below illustrate the variation in sample results from each site in 2015.



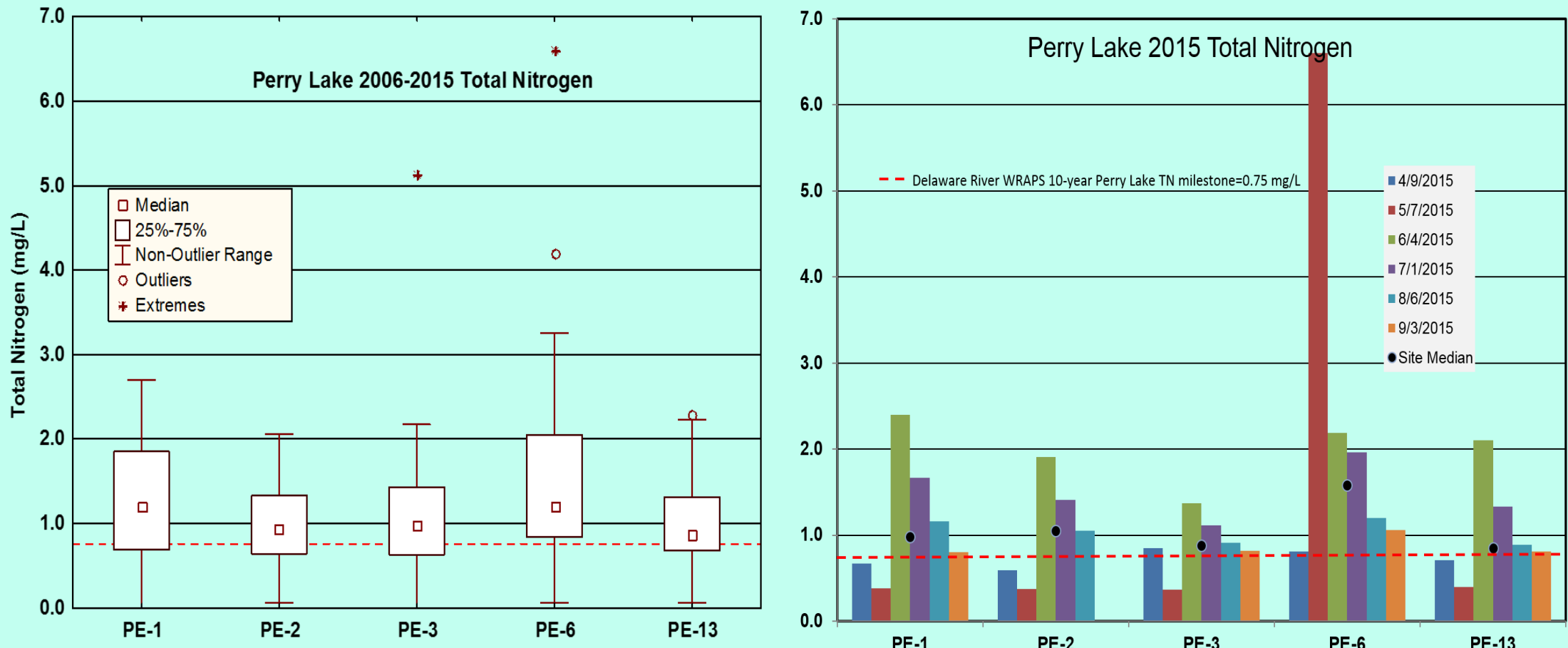
Total Phosphorus

Total phosphorus (TP) median concentrations in 2015 exceeded 75% of the 10-year data at Perry Lake sites and outflow. TP median concentrations from 2006-2015 lake samples were near to EPA approved 10-year goals set by Delaware R. WRAPS, except at sites PE-1 and PE-6 where results were 2 to 3 times higher. Many of the outlier and extreme TP values recorded in the 10-year box plot graph were results of the high inflows and phosphorus load recorded in 2015. Rock Creek (PE-13) median TP concentration in 2015 exceeded 95% of the data collected from 2006-2015. Phosphorus released by bottom sediments (i.e. internal loading) was not apparent in monthly trends in 2015. Significant inflow events in May and June were the primary influence on monthly total phosphorus concentrations.



Total Nitrogen

In 2015, median total nitrogen (TN) concentrations were slightly higher than 10-year milestones set by Delaware River WRAPS. Median TN concentrations were near 10-year medians at all sites. High levels of nitrates related to a large inflow event contributed to the extreme (i.e. at least 3 times higher than 25-75% box height) TN concentration measured in May samples at PE-6. TN concentrations can be highly variable between sites and years and most related to stream discharge and watershed factors (i.e. soils and farming practices).



Water Quality Concerns:

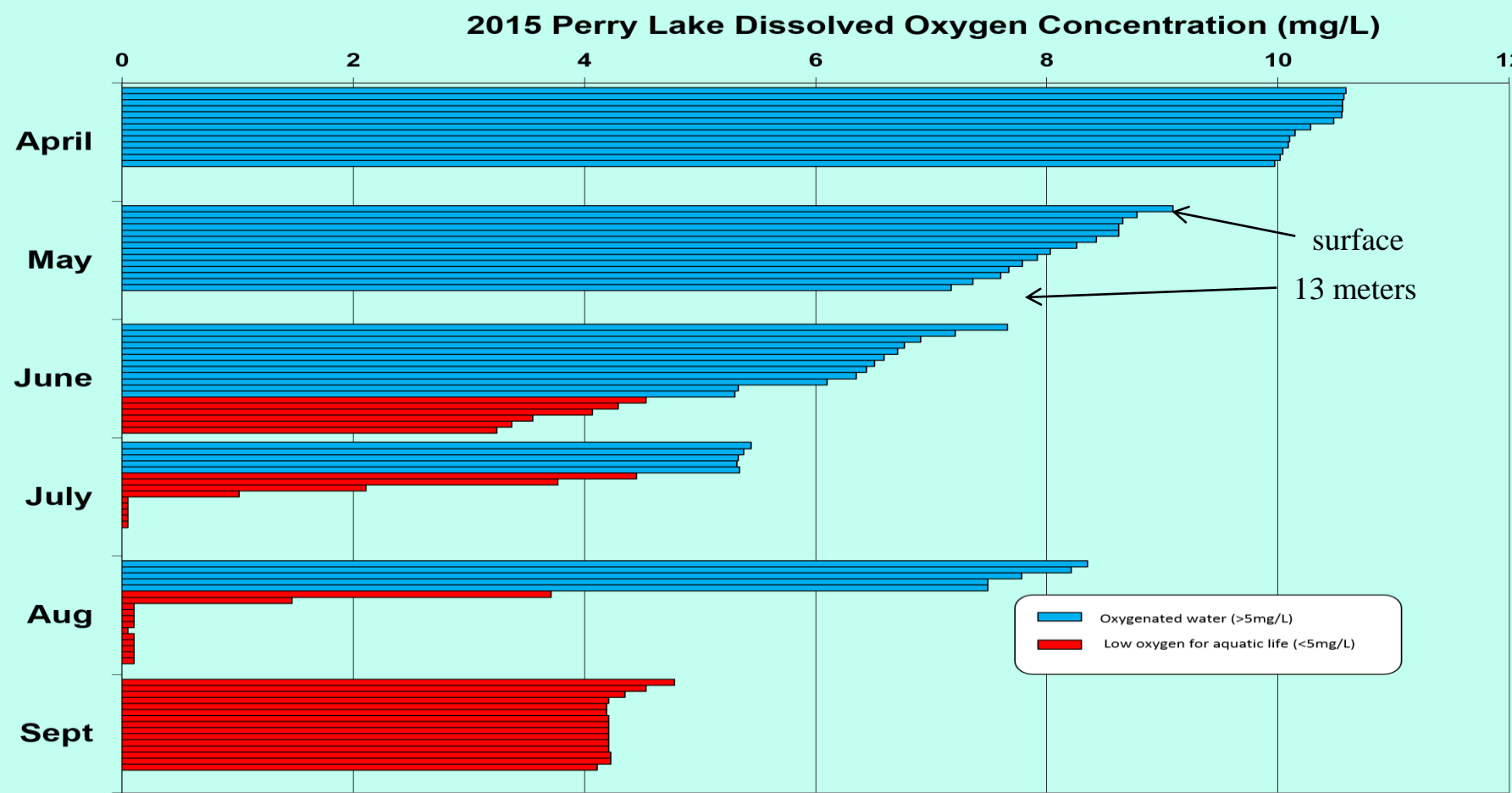
- Eutrophication
- Sediment inputs
- Herbicides
- Algae Blooms



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Dissolved Oxygen

Dissolved oxygen is a key factor in aquatic species location, growth, and ultimately survival in lakes. The figure below illustrates dissolved oxygen measured in the water column in one-meter intervals (e.g. each row in each month represents one meter of depth) from April through September. Perry Lake stratifies for a short period of the summer, but adequate (5 mg/L) dissolved oxygen is available. In 2015, at least the top 5 meters of the lake were well oxygenated for fish and aquatic life during periods of summer stratification. September sampling coincided with turnover when the lake de-stratified and low oxygen water from below the thermocline mixed with surface water. This naturally causes a short period of well mixed and poorly oxygenated water.



Total Suspended Solids

Total Suspended Solids (TSS) is descriptive of erosion in river basins, sedimentation or filling rates of downstream reservoirs, and is also closely linked to nutrient and contaminant transport through river systems. Perry Lake 2015 TSS values in the upper lake were above average for District lakes. However, 94% of TSS settled out as water moved from the upper lake to the dam. This high percentage of sediment loss from upper lakes sites to lower lake sites is related to sediment trapping efficiency and rate of sedimentation. Timing of sample collection related to inflow events is one bias affecting comparisons of sediment measures in inflows. Land use influence on this graphic is apparent as inflow streams carrying the highest concentrations of suspended solids are typically larger streams with high percentage of row crop agriculture or exposed soil.

